STUDIES ON THE PHYSICO CHEMICAL AND HEAVY METAL QUALITY OF SELECTED GROUND WATER SAMPLES IN VISAKHAPATNAM CITY, ANDHRA PRADESH, INDIA.

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Water, also called the Elixir of life, is an essential unique universal solvent needed for any living organism. Life is not possible on this planet without water as it acts as a media for both chemical and biochemical reactions and also as an internal and external medium for several organisms.

Since time immemorial Humans have depended on this vital medium, as can be seen from historical and Archaeological facts. Great civilizations have developed around water sources and crumbled in its absence. Due to the immense importance of water, the UN General Assembly, on July-2011, declared safe and clean drinking water and sanitation as human right essential to the full enjoyment of life and all other human rights (WHO, 2011). The UN has earmarked March 22nd of every year as the 'World Water Day' and has declared the period between 2005 and 2015 as international decade for action on proper utilization of water (water for life).

Though there is ample water on the Earth (71% of the earth is covered with water), the available usable water, with respect to humans, is very meager (0.014% of the total global water) resulting in frequent water famines/crises and water wars. About 97.2% of water on earth is salty making it unusable and the 2.8% present as fresh water needs to be managed very carefully to meet our ever-increasing needs

Off-late there is a lot of stress on the availability of fresh water for our needs. The Population has increased 50 fold whereas water resources remained the same in the last 2000 years. Moreover with increase in technology and standards of living we are consuming more water than before. Water usage has increased in all aspects. Industrial revolution and rapid industrialization has added a new sink for freshwater, not existing previously.

Water is one of the materials required to sustain life and has long been suspected of being the source of much human illness. The public has been more exacting in its demands as time has passed, and today water energies and public health experts are expected to produce finished water that is free of colour, turbidity, taste, odor, nitrate, harmful metal ions, and a wide variety of organic chemicals such as pesticides and chlorinated solvents. Health problems associated with some of these chemicals include

cancer, birth defects, central nervous system disorders, and heart disease. In addition the public desires water that is low in hardness and total solids, noncorrosive, and non scale forming. To provide such water, chemists, biologists, and engineers must combine their efforts and talents.

The total quantity and quality of water in aquifer system at any giventime is dependent on many factors. These factors include storage capacity of lakes, Wetlands and Artificial reservoirs, the permeability, the soil beneath these storage bodies, the runoff characteristics of the land in the watershed, the timing of the precipitation and local evaporation rates. Sub-surface water, or groundwater, is fresh water located in the pore space of soil and rocks. It is also water that is flowing within aquifers below the water table. Sometimes it is useful to make a distinction between sub-surface water that is closely associated with surface water and deep sub-surface water in an aquifer.

Water pollution has been seriously affecting the life of humans , plants as well as animals . The eco-system of rivers, streams, lakes, seas and oceans is also getting deteriorated due to the contamination of water through various sources. This condition also leads to the outbreak of numerous diseases, majority of them being lethal and contagious . Dumping of industrial wastes, containing heavy metals , harmful chemicals, by-products , organic toxins and oils, into the nearby source of water is one of the visible causes of water pollution. Another cause for the contamination of water is the improper disposal of human and animal wastes. Effluents from factories, refineries, injection wells and sewage treatment plants are dumped into urban water supplies, leading to water pollution. A number of pollutants, both harmful and poisonous, enter the groundwater systems through rain water. The residue of agricultural practices, including fertilizers and pesticides, are some of the major sources of water pollution. Untreated pollutants are drained into the nearest water body, such as stream, lake or harbor, causing water pollution. Another major source of water pollution comprises of organic farm wastes. When farm land, treated with pesticides and fertilizers, is irrigated, the excess nitrogen and poisons get mixed into the water supply there by contaminating it. Pathogen sediments and chemical pollutants are other

sources of water pollution. The corporeal wastes produced by humans and farmed organisms pollute rivers, lakes, oceans and other surface waters.

When the water quality deteriorates, water uses may successively shift from drinking water to bathing water, water for livestock, agriculture and industrial uses and so on .Pollution also creates water scarcity in regions which otherwise have abundant water resources. Ground water which is used to provide guarantee against pollution has not been spared either. Not only do pollutants from surface sources leach into the aquifer below, but with increasing ground water exploitation, inorganic components like fluoride and arsenic present below the ground also find their way into the extracted water.

In general, shallow, permeable water table aquifers are the most susceptible to contamination, but susceptibility of all aquifers to contamination is determined largely by such site-specific characteristics as:

1. Distance from the contamination source to the aquifer and residence time of the water in the unsaturated zone;
2. presence of clay and organic matter in the unsaturated zone materials;
3. potential of a particular contaminant to biodegrade and decompose;
4. amount of precipitation, which affects recharge and the rate at which contaminants move downward;
5. Evapotranspiration, which in recharge areas may decrease the amount of water that moves downward to the aquifer.

Visakhapatnam is a rapidly growing city both industrially and demographically. This sudden growth of population coupled with poor infrastructure and inadequate waste management and pubic sanitation services is bound to create problems in the public health sector. Since the most important medium of contamination is domestic water, it needs to be constantly monitored in all aspects with reference to aquifer hydrodynamics.

The present study deals with the quality of ground water in and around Visakhapatnam city. During the course of this present study, 40 ground water samples were collected and examined for Physico chemical, heavy metal parameters.

The present study was divided in to seven chapters.

Chapter -1. The authorpresented Introduction to importance of the ground water and quality. This chapter detailed the importance on ground water protection and growing negative impact of industrial and technological progress on the environment in terms of its pollution and degradation.

Chapter -2. The author presented contemporary review of literature on the ground water quality. In this chapter the author presented the contemporary findings on ground water pollution in International, national, and local chronologically.

Chapter -3.A detailed methodology of the experiment conducted and the study area it has been conducted has been described in this chapter. The water has been analyzed for Physico-chemical parameters and Heavy metal concentration. Each parameter has been explained in detail and the description of the standard method followed for detecting each parameter has been elucidated.

Chapter -4. In this chapter the results of the Physico chemical quality and heavy metal contamination of the ground water in the study area are presented.The analyzed parameters are P^H, Conductivity, Total Dissolved Solids (TDS), Chloride, Total Hardness, Total Alkalinity, Fluoride, Nitrate, Sulphate, Phosphate and DO. The author retrieved statistical analysis on Water Quality Index (WQI), Correlation were presented. The variations among different sampling locations according to the classified zonation were presented in graphs and were discussed. Grading was assigned to each water sample based on its quality. Environmental quality and reasons for ground water pollution were mentioned.The heavy metal contamination of ground water is discussed in depth. The analyzed parameters are Arsenic (As), Chromium (Cr^{+6}), Iron (Fe), Cobalt (as Co),Nickel (Ni), Manganese (Mn), Zinc (Zn), Lead (Pb), Cadmium (Cd), Mercury (Hg), Copper (Cu).The results that exceeded the permissible limit were discussed. Impacts of

industrialization and Urbanization were discussed in detail. Remedial measures were also added in to the discussion.

Chapter -5. In this chapter the author presented overall discussions on the reasons for ground water contamination and management of ground water resources and suggested recommendations for the protection and management.

Chapter-6. The author presented references cited in the study.

The results of the study revealed that the water quality in most of the study areas was under the acceptable limits. The water quality is unfit for human consumption owing to its physico-chemical parameters. But more disturbing is the concentration of heavy metals in the potable ground water. The author ascribes it to the pollution of aquifers caused by domestic sewage, industrial pollution and agriculture runoff. The author further suggests remediation measures to counteract the problems and water treatment methods for specific problems.

Observations on performance in relation to standards are known as monitoring, hence the author delineated that continual quality control function is an integral part of the responsibilities of the local government agency where as the surveillance function usually rests with health authorities and environmental engineers at local, regional and national levels. The author also delineated that sanitary inspections are useful monitoring tools and are sometimes the only affordable means of identifying water sources at risk of contamination preventingfuture pollution toprecious ground water resources.